Exemption No. 5587E

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
RENTON, WASHINGTON 98055-4056

In the matter of the petition of

British Aerospace Regional Aircraft

for an exemption from 14 CFR §§ 25.562(c)(5) and 25.785(a)

Regulatory Docket No. 27001

PARTIAL GRANT OF EXEMPTION

By letter AWP/J41/250/970363 dated June 30, 1997, N. S. G. Wright, Chief Airworthiness Engineer, British Aerospace Regional Aircraft (formerly Jetstream Aircraft Limited), Prestwick International Airport, Ayrshire KA9 2RW, Scotland, petitioned for an extension to Exemption 5587D regarding the Head Injury Criterion (HIC) of 14 CFR §§ 25.562(c)(5) and 25.785(a), for front row passenger seating in Jetstream Series 4100 airplanes, until March 31, 1998. The existing exemption expires on September 30, 1997.

Sections of the FAR affected:

Section 25.785(a) requires that each seat, berth, safety belt, harness, and adjacent part of the airplane at each station designated as occupiable during takeoff and landing must be designed so that a person making proper use of those facilities will not suffer serious injury in an emergency landing as a result of inertia forces specified in §§ 25.561 and 25.562.

Section 25.562(c)(5) requires that each occupant must be protected from serious head injury under the conditions prescribed in paragraph (b) of this section. Where head contact with seats or other structure can occur, protection must be provided so that the head impact does not exceed a Head Impact Criterion (HIC) of 1,000 units. The level of HIC is defined by the equation:

$$HIC = \left[(t_2 - t_1) \left[\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a(t)\, dt \right]^{2.5} \right]_{max}$$

ANM-97-037-E

The petitioner's supportive information is as follows:

1. SUMMARY

BAe requests a further extension of the termination date of Exemption 5587D until 31 March 1998. Exemption 5587D grants relief from compliance with the Head Injury Criteria of FAR Part 25 for the front row passengers of the Jetstream Model 4101 airplane until 30 September 1997. This further extension is sought to allow BAe to deliver new airplanes with an economically viable seating configuration whilst BAe pursues the design, development and certification of a front row passenger protection system.

2. PROPOSED AMENDMENT

BAe proposes that the expiry date of exemption 5587D be amended from 30 September 1997 to 31 March 1998.

3. INTERESTS OF THE PETITIONER AND PUBLIC

a) BAe is the manufacturer of the Jetstream Model 4101 airplane and the holder of FAA Type Certificate A41NM. BAe is pursuing marketing opportunities for J41 airplanes for delivery to U.S. Operators during 1997 and the continuation of existing leasing arrangements with U.S. Operators. Whilst BAe is ceasing production of the J41 at the end of 1997 BAe will remain committed to the continued support of the aircraft for the foreseeable future. These airplanes cannot be operated with an economically viable seating configuration without relief from the cited rules. BAe will suffer serious financial consequences should it be unable to offer airplanes with existing seating configurations.

b) U.S. operators will suffer serious financial burdens should they be unable to operate airplanes to the previous maximum seating capacity.

   i) Operators plan their operations on the assumption that the specified seating configuration will be available.

   ii) Operation of airplanes with the front row seats unavailable for use would seriously degrade the operating economics of the airplane by reducing the achievable revenue but without any possibility of a proportionate reduction of the operating costs.

c) The traveling public would be adversely affected by a reduction in the available seating capacity.

   i) Some peak-time travelers would be denied transportation because the demand for seats on popular flights would exceed the number planned to be available.

ii) An increase in the cost of airfares would be necessary to re-establish the economic viability of the operation. If this option was judged to be unacceptable then withdrawal of the service could ensue. Neither of these possibilities would benefit the traveling public.

4. SUPPORTING INFORMATION

a) BAe has applied for, and been granted, temporary exemptions from the cited FAR 25 paragraphs on five occasions since October 1992.

BAe acknowledges the safety benefits of the rules and remains committed to developing an acceptable solution which provides passengers with the protection intended by the rules. However, the development time for the system has proven to be longer than predicted and consequently a further temporary extension of the compliance date is sought.

BAe, working with Simula Government Products Inc, has been and is continuing to actively develop a passenger head protective system using inflatable airbags similar to those in common use in the automotive industry. BAe's progress with this development program has been regularly reported to the FAA as required by exemption 5587D. Recently BAe has reported its investigation into alternative solutions to mitigate against possible delays in certification of the airbag solution.

b) Exemption 5587D contains the following conditions : -

i) That BAe submit quarterly progress reports to FAA outlining progress and future planned activities.
BAe has complied with this condition, the second report of 1997 being published at the end of June 1997.

ii) That BAe submit a schedule for the retrofit of the design solution to the fleet prior to the expiration of the exemption.

BAe will not be able to submit a retrofit schedule in this timescale because: -

(1) The design solution has not been finalized.
Supply of the systems for shipment to and installation in affected airplanes cannot occur until the design is complete and compliance with the special conditions has been demonstrated. Furthermore, the airplane down-time required to install the system cannot be accurately determined until all details of the installation have been finalized.

(2) The retrofit schedule will depend on the location of the airplanes and the fleet availability requirements of the operators. The co-operation of, and co-ordination with, the operators will be necessary. Whilst BAe has no reason to expect that the disposition of the fleet will change during 1997/1998, any major changes could have a significant impact on the schedule. Each operators fleet size, utilization schedule, and required airplane down-time all have a significant effect on the overall retrofit schedule.

BAe therefore submits that attempting to formulate a schedule before 30 September 1997 is premature.

c) In the granting of Exemption 5587D the FAA make some observations relevant to this application :-

i) "*. . . the air-bag. . poses a complicated certification problem and should be fully developed before it is implemented . .* "

BAe agrees with the FAA that the problem is more complicated than originally envisioned when BAe committed to the air-bag solution and anticipated having a system available by the end of 1996.

The following significant factors were highlighted in the previous petitions are still relevant to this petition. These are repeated below.

(i) In developing guidelines and design specifications, BAe and Simula have been drawing on the experience gained with air-bags in the road transport sector. Comparison between automotive and aviation applications has revealed significant differences that lead to the aviation application being more difficult to solve.

(ii) Automotive passengers are generally always seated upright, facing forward and wearing a shoulder restraint. The air-bag is regarded as a supplementary head restraint system.

Airplane passengers will not be wearing a shoulder restraint and consequently the air-bag will be the primary head protection system.

(iii) Automotive accidents occur in a very short timeframe with passengers having no time to prepare for impact.

Aviation accidents in which air-bags may be expected to fulfill their intended purpose are usually preceded by enough time for passengers to prepare themselves for impact. Airplane passengers may either be seated

upright or adopting the brace position. Passenger safety considerations dictate that air-bag deployment while the passenger is in the brace position must be shown to be non-hazardous and this factor imposes an additional constraint on the design of the system that is not duplicated in the automotive field.

(iv) There is a larger distance between the bulkhead mounted air-bag and passenger in an airplane than there is in a road vehicle. This larger distance is technically very significant and has contributed to the difficulty in resolving the head-strike problem.

(v) Motor vehicle accidents are likely to occur at any time that the vehicle is in motion and automotive air-bag systems therefore must be enabled and ready for deployment at all times.

Although airplanes are exposed to the possibility of ground-impact accidents at all times while airborne, the air-bag system needs to be available for only a relatively short period during the take-off and landing phases of each flight. In order to reduce the possibility of injury to occupants by inadvertent in-flight deployment of the air-bag, a deployment control system that suitably limits the period when the air-bag is available for use may be necessary. Such control systems are unnecessary in road vehicles.

d) BAe is also pursuing JAA certification of the proposed air-bag system for installation in airplanes certificated in accordance with the JAA certification basis.

In accordance with JAA policy applicable to all aircraft types which are subject to JAR 25.562(c)(5) and JAR 25.785(a), the JAA have exempted the Jetstream 4100 from compliance with these requirements until lst January 1998. BAe will be applying to extend this further.

The JAA are also developing special conditions and associated acceptable means of compliance for the passenger air-bag system. The FAA and JAA have been conferring on the matter of certification requirements for air-bag systems in an attempt to achieve a common approach to the problem and there is general agreement between FAA and JAA on the technical issues and submit that a common compliance date is consistent with the Harmonization objective.

e) The emphasis within BAe of the route towards providing a solution for compliance with HIC requirements for front seat row passengers had moved towards developing a certifiable airbag system and this was reflected in the FAA observations given in Exemption 5587D, except that the FAA made the following new observation:

"*..... one manufacturer has installed upper torso restraints as a means Of compliance with front row HIC. The FAA is not aware of any adverse reaction to this installation from the flying public. Thus, FAA cannot justify the exclusion of upper torso restraints on the basis of commercial ground in the future".*

Recognizing this fact and in view of additional problems found during Dynamic Testing of the Airbags, and also in view of adverse media publicity both in the U.S. and the U.K. about the injuries and deaths arising from the use of airbags in U.S. automobiles, BAe has opted to pursue in parallel other alternative solutions which are described below

i) Headpad Testing.

Although BAe has carried out many Headpad Tests in earlier years with disappointing results it was decided to investigate the use of an open celled, rate dependent, slow recovery polyurethane foam known as Confor

foam which has found a successful application in the motor racing world for driver protection.

Full scale sled testing between December 1997 [sic] and March this year at Millbrook involving the use of Confor crash pads again produced unacceptable HIC values. No further activity is currently planned following the unacceptable results.

ii) Front Row Seats fitted with Shoulder Harnesses.

Although the use of shoulder harnesses had been identified several years ago by BAe as a possible solution to the HIC problem for the front row market research at that time showed that the Airlines' perception was that these would be unacceptable to the traveling public. Since however it was known that another manufacturer had successfully certificated and introduced these items into service, contact was made with the same seat manufacturer concerning a possible joint development programme. The timescales offered were beyond the current exemption limits however so it was decided to develop a harness solution with anchorages in the aircraft structure and make use of the existing seats.

A test schedule was created and agreed with the JAA. This involved the testing of a layout representing the first two rows of double seats behind the wardrobe on the R.H. side of the aircraft, all seats being occupied by instrumented dummies.

Initial testing has been promising enough for BAe to continue its activities towards certificating this system in parallel with airbags.

Discussion with the JAA have yielded encouraging comments. The JAA's initial reaction is that no new special conditions are anticipated.

5. CONCLUDING REMARKS:

As a result of two unsuccessful dynamic certification tests, and other difficulties which have been reported to FAA, BAe is now unable to accurately predict a certification date for this project.

As a contingency, BAe has re-opened investigation of other solutions, namely head strike pads and shoulder harnesses.

BAe believes that before the 31st March 1998 there will be at least one certificated solution to the problem and an FAA agreed programme for retrofitting all in-service aircraft will be in place. It is for this reason that a further six months extension to the exemption has been requested.

For the reasons set out in this petition, BAe submits that granting the requested temporary exemption does not adversely affect public safety and is in the public interest.

A summary of the petitioner's request for an extension to Exemption 5587D was published in the Federal Register on August 1, 1997 (62 FR 41475). No comments were received.

The FAA's analysis/summary is as follows:

Exemption 5587D was issued after careful consideration of the continuing efforts that BAe was making to achieve compliance, and in recognition of an unforeseen parts availability problem that delayed the overall schedule for implementation. Since the issuance of that amendment, additional technical problems have developed that throw the completion date of the program into question.

The FAA continues to believe that the airbag has the potential to provide a level of safety even greater than that required by the rule, and thus is interested in seeing its development come to fruition. The FAA considers the installation of airbags on airplanes a novel and unique feature, and has issued special conditions 25-ANM-127, which prescribe appropriate certification criteria.

As noted in the granting of Exemption 5587D, one manufacturer has installed upper torso restraints as a means of compliance with front row HIC. As noted in that exemption and restated in this petition, the FAA cannot justify the exclusion of upper torso restraints on

the basis of commercial grounds in the future. Considering that BAe is also pursuing the development of upper torso restraints as a means of compliance the FAA cannot forego the implementation of this now proven means of compliance, in favor of one as yet not qualified. Nonetheless, the FAA is interested in seeing the airbag developed to the extent that its viability can be known. An outright denial of this petition would likely cause the airbag work to be aborted in favor of the most expedient solution.

The FAA considers that any further deliveries (after September 30, 1997) of Jetstream 4101 airplanes should be in compliance with HIC for front row passengers. An extension of the exemption for new deliveries has not been justified, considering that such deliveries are not specified. Therefore, the main issue concerning the disposition of this petition is the existing fleet and its retrofit.

The FAA recognizes that it is not practical to expect a retrofit of the existing fleet, with whichever solution is ultimately chosen, by the expiration date of this exemption. However, the FAA does expect that a schedule for accomplishing the retrofit will be approved prior to the expiration of this exemption, and that the retrofit will be accomplished in a timely manner, commensurate with the safety implications and the complexity of the solution. Since the course of action has not yet been determined, the FAA will allow some additional time in order to establish the retrofit schedule, and in particular the date for completion of the retrofit. It should be possible to do this, considering either of the two options now under consideration.

Therefore, the FAA will extend this exemption until March 31, 1998 for airplanes delivered prior to September 30, 1997, provided that a schedule for retrofit is submitted for approval by January 31, 1998. This will allow sufficient time for the FAA to make a decision regarding the acceptability of the proposed schedule, and allow for correction if necessary.

Given the relative maturity of the airbag system development, the FAA is concerned that a denial of this request might jeopardize completion of a program that has shown great promise. In addition, there would be a severe cost impact to operators, since the only available solution in the near term would be removal of seats. Therefore, together with the fact that the resultant product will likely provide a higher level of safety than might other means of compliance, the FAA considers that an extension of the existing compliance time is reasonable.

In consideration of the foregoing, I find that a partial grant of exemption is in the public interest, and will not significantly affect the overall level of safety provided by the regulations. Therefore, pursuant to the authority contained in 49 US 40113 and 44701, formerly §§ 313(a) and 601(c) of the Federal Aviation Act of 1958 as amended, delegated to me by the Administrator (14 CFR 11.53), the petition of British Aerospace Regional Aircraft for an extension to Exemption 5587 regarding the HIC requirements of 14 CFR §§ 25.562(c)(5) and 25.785(a), for front row passenger seats on Jetstream Series 4100 airplanes, is granted until March 31, 1998, with the following provision:

1. The petitioner shall submit a schedule for retrofit of the design solution prior to January 31, 1998.

2. This extension applies only to airplanes delivered prior to September 30, 1997.

All other provisions of Exemption 5587, together with its conditions and limitations, remain the same and are applicable to this exemption. This amendment is part of, and shall be attached to, Exemption 5587.

Issued in Renton, Washington, on September 15, 1997.

/s/
James V. Devany
Acting Manager,
Transport Airplane Directorate,
Aircraft Certification Service, ANM-100

F:\Home\jgardlin\regs\exempts\jethic6.doc